

Topics 3.1 – 3.3, 3.6 – 3.8 Option C

## 3.1 Chemical elements and water

Assessment Statement	Study information
3.1.1 State that the most frequently occurring chemical elements in living things are carbon, hydrogen, oxygen and nitrogen.	<p>List 2 types of molecules that contain C, H, and O.</p> <p>List 2 types of molecules that contain C, H, O, and N.</p>
3.1.2 State that a variety of other elements are needed by living organisms, including sulfur, calcium, phosphorus, iron and sodium.	<p>Give the atomic symbol for each of the important elements.</p> <p>Sulfur –</p> <p>Calcium -</p> <p>Phosphorus –</p> <p>Iron –</p> <p>Sodium –</p>
3.1.3 State one role for each of the elements mentioned in 3.1.2.	<p>For each element, name a specific molecule or structure it is important to in the body.</p> <p>Sulfur:</p> <p>Calcium:</p> <p>Phosphorus:</p> <p>Iron:</p> <p>Sodium:</p>
3.1.4 Draw and label a diagram showing the structure of water molecules to show their polarity and hydrogen bond formation.	<p>Draw 2 water molecules. Label polarities on each water molecule. Label the covalent and hydrogen bonds.</p>
3.1.5 Outline the thermal, cohesive and solvent properties of water	<p>Explain the thermal properties of water.</p> <p>Explain the cohesive properties of water.</p>

	Explain why water is a good solvent.
3.1.6 Explain the relationship between the properties of water and its uses in living organisms as a coolant, medium for metabolic reactions and transport medium.	<p>Describe why water is a good coolant.</p> <p>Explain why water makes a good medium for metabolic reactions.</p> <p>Describe why water makes a good transport medium.</p>

## 3.2 Carbohydrates, lipids and proteins

Assessment Statement	Study information
3.2.1 Distinguish between organic and inorganic compounds.	<p>Define organic compound and give an example of one.</p> <p>Define inorganic compound and give an example of one.</p>
3.2.2 Identify amino acids, glucose, ribose and fatty acids from diagrams showing their structure.	<p>Draw the molecular structure of an amino acid.</p> <p>Draw the molecular structure of glucose.</p> <p>Draw the molecular structure of ribose.</p> <p>Draw the molecular structure of a fatty acid.</p>



	<p>Identify the function of a fat lipid.</p> <p>Identify the function of a phospholipid.</p>
3.2.7 Compare the use of carbohydrates and lipids in energy storage.	<p>Explain how carbohydrates are used for energy storage.</p> <p>Explain how lipids are used for energy storage.</p> <p>Identify one similarity between using carbohydrates and fats for energy storage.</p> <p>Identify one difference between using carbohydrates and fats for energy storage.</p>

### 3.3 DNA structure

Assessment Statement	Study Information
3.3.1 Outline DNA nucleotide structure in terms of sugar (deoxyribose), base and phosphate.	Draw the generalized structure of a nucleotide.
3.3.2 State the names of the four bases in DNA.	<p>A _____</p> <p>T _____</p> <p>C _____</p> <p>G _____</p> <p>Write the base pairing rules: _____</p>
3.3.3 Outline how DNA nucleotides are linked together by covalent bonds into a single strand.	Draw one strand of a DNA molecule with 2 nucleotides. Label the covalent bond connecting them.

3.3.4 Explain how a DNA double helix is formed using complementary base pairing and hydrogen bonds	Draw a double stranded DNA molecule comprised of 1 base pair. Label the hydrogen bonds.
3.3.5 Draw and label a simple diagram of the molecular structure of DNA.	Draw a double stranded DNA molecule comprised of 2 base pairs (4 nucleotides). Label the covalent and hydrogen bonds.

## 3.6 Enzymes

Assessment Statement	Study Information
3.6.1 Define enzyme and active site.	Answer the assessment statement using a diagram.

3.6.2 Explain enzyme–substrate specificity.	Answer the assessment statement using a diagram.
3.6.3 Explain the effects of temperature, pH and substrate concentration on enzyme activity.	<p>How does temperature affect enzyme activity?</p> <p>How does pH affect enzyme activity?</p> <p>How does substrate concentration affect enzyme activity?</p>
3.6.4 Define denaturation.	Answer the assessment statement.
3.6.5 Explain the use of lactase in the production of lactose-free milk.	<p>Explain what lactase is.</p> <p>Explain why lactose-free milk needs to be produced.</p> <p>Explain how lactase is used to make lactose-free milk, including the chemical reaction.</p>

### 3.7 Cell respiration

Assessment Statement	Study Information
3.7.1 Define cell respiration.	Answer the assessment statement.
3.7.2 State that, in cell respiration, glucose in the cytoplasm is broken down by glycolysis into pyruvate, with a small yield of ATP.	Draw out the steps of glycolysis. Be sure to hi-light the energy investment and energy yielding steps.
3.7.3 Explain that, during anaerobic cell respiration, pyruvate can be converted in the cytoplasm into lactate, or ethanol and carbon dioxide, with no further yield of ATP.	Draw the generalized equation for lactic acid fermentation (anaerobic cell respiration).  Draw the generalized equation for alcohol fermentation (anaerobic cell respiration).
3.7.4 Explain that, during aerobic cell respiration, pyruvate can be broken down in the mitochondrion into carbon dioxide and water with a large yield of ATP.	Write the generalized equation for aerobic cellular respiration.

### 3.8 Photosynthesis

Assessment Statements	Study Information
3.8.1 State that photosynthesis involves the conversion of light energy into chemical energy.	<p>Write out the generalized equation for photosynthesis.</p> <p>Circle the light energy component and star the chemical energy component in the equation.</p>
3.8.2 State that light from the Sun is composed of a range of wavelengths (colours).	<p>Draw a diagram of the electromagnetic spectrum. Be sure to label UV light, all the visible light colors, and infrared.</p>
3.8.3 State that chlorophyll is the main photosynthetic pigment.	<p>Explain the role of chlorophyll in photosynthesis.</p>
3.8.4 Outline the differences in absorption of red, blue and green light by chlorophyll.	<p>Draw a graph of the absorption spectrum (wavelength on x-axis, absorption on y-axis). Be sure to label the colors under the appropriate wavelengths.</p>



<p>3.8.5 State that light energy is used to produce ATP, and to split water molecules (photolysis) to form oxygen and hydrogen.</p>	<p>Draw a diagram of photosystem II and its electron transport chain. Label light energy, electron movement, water, oxygen, hydrogen motion, and ATP synthase.</p>
<p>3.8.6 State that ATP and hydrogen (derived from the photolysis of water) are used to fix carbon dioxide to make organic molecules.</p>	<p>Explain the role of ATP in the Calvin cycle.</p> <p>Identify the molecule accepts <math>H^+</math> (along with an electron). _____  Explain the role of this molecule in the Calvin cycle.</p>
<p>3.8.7 Explain that the rate of photosynthesis can be measured directly by the production of oxygen or the uptake of carbon dioxide, or indirectly by an increase in biomass.</p>	<p>Explain an experimental design for measuring the rate of photosynthesis by measuring the oxygen production of a water plant.</p> <p>Explain an experimental design for measuring the rate of photosynthesis by measuring increase in biomass (growth of a plant).</p>



<p>C.1.2 Outline the difference between fibrous and globular proteins, with reference to two examples of each protein type.</p>	<p>Give two examples of a fibrous protein.</p> <p>Draw a sketch of one of them.</p> <p>Give two examples of a globular protein.</p> <p>Draw a sketch of one of them.</p> <p>Describe two differences between these two types of proteins (be sure to identify at least one difference at the secondary level of protein structure).</p>
<p>C.1.3 Explain the significance of polar and non-polar amino acids.</p>	<p>Identify and draw the molecular structure of a polar amino acid.</p> <p>Will the polar amino acid be found on the outside or inside of a globular protein?        _____ Explain why.</p> <p>Identify and draw the molecular structure of a non-polar amino acid.</p> <p>Where would a non-polar amino acid be found in a membrane channel protein?        Explain why.</p>

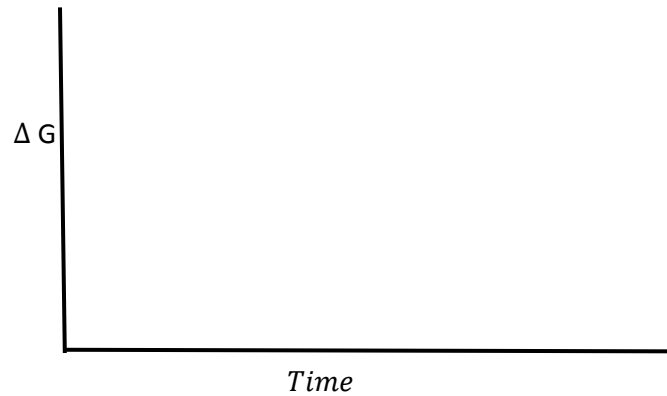
<p>C.1.4 State four functions of proteins, giving a named example of each.</p>	<p><u>Immunological protein function:</u></p> <p>Named example –</p> <p><u>Hormonal protein function:</u></p> <p>Named example –</p> <p><u>Enzymatic protein function:</u></p> <p>Named example –</p> <p><u>Structural protein function:</u></p> <p>Named example -</p>
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## C2 Enzymes

Assessment Statement	Study Information
<p>C.2.1 State that metabolic pathways consist of chains and cycles of enzyme catalyzed reactions.</p>	<p>Draw a diagram of a metabolic pathway comprised of at least 3 individual reactions.</p> <p>Label the enzymes that control this metabolic pathway.</p>
<p>C.2.2 Describe the induced-fit model.</p>	<p>Describe the lock and key model using a diagram. Label the enzyme and substrate.</p> <p>Explain how the induced-fit model is slightly different.</p>

**C.2.3 Explain that enzymes lower the activation energy of the chemical reactions that they catalyse.**

Draw a graph of an exothermic reaction without the addition of an enzyme.



Draw a second line showing an exothermic reaction with the addition of an enzyme. Label the activation energy.

C.2.4 Explain the difference between competitive and non-competitive inhibition, with reference to one example of each.

Explain, with the help of a diagram, competitive inhibition. Be sure to label the active site, enzyme, substrate, and inhibitor.

Explain, with the help of a diagram, non-competitive inhibition. Be sure to label the active site, enzyme, allosteric site, substrate, and inhibitor.

**C.2.5** Explain the control of metabolic pathways by end-product inhibition, including the role of allosteric sites.

Draw a metabolic pathway comprised of at least 3 reactions. Diagram the final product non-competitively inhibiting the first enzyme of the pathway.

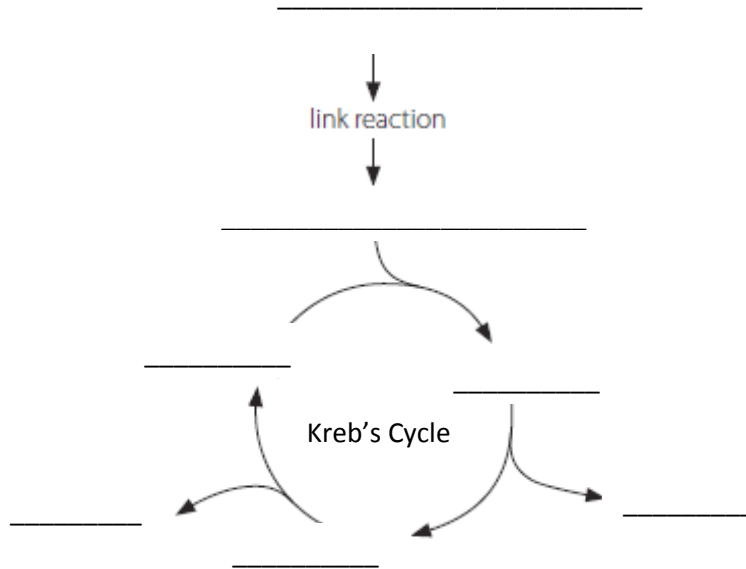
## C3 Cell respiration

Assessment Statement	Study Information
C.3.1 State that oxidation involves the loss of electrons from an element, whereas reduction involves a gain of electrons; and that oxidation frequently involves gaining oxygen or losing hydrogen, whereas reduction frequently involves losing oxygen or gaining hydrogen.	LEO the lion says GER. What does LEO stand for?  What does GER stand for?  When electrons move, what other ion typically moves with them?
C.3.2 Outline the process of glycolysis, including phosphorylation, lysis, oxidation and ATP formation.	Diagram all the steps in glycolysis (from glucose ending with 2 pyruvate). Label the phosphorylation step, lysis, oxidation, and ATP formation.
C.3.3 Draw and label a diagram showing the structure of a mitochondrion as seen in electron micrographs.	Draw a diagram of a mitochondrion. Label the outer membrane, inner membrane, cristae, matrix, inner membrane space, and ribosomes.

C.3.4 Explain aerobic respiration, including the link reaction, the Krebs cycle, the role of NADH + H<sup>+</sup>, the electron transport chain and the role of oxygen.

Draw the link reaction.

Fill out the diagram below. Be sure to label NAD<sup>+</sup>, NADH, FAD, FADH<sub>2</sub>, ADP, and ATP. Include the number of carbons along with molecule names.



C.3.5 Explain oxidative phosphorylation in terms of chemiosmosis.

Draw a diagram of ATP synthase. Use the diagram to explain how ATP is synthesized from ADP and P<sub>i</sub> in mass quantities.

C.3.6 Explain the relationship between the structure of the mitochondrion and its function.

Draw the structure of a mitochondrion. Label the inner membrane, outer membrane, matrix, and inner mitochondrial space.

	<p>Explain why the increased surface area of the cristae increase the efficiency of the electron transport chain and <math>H^+</math> flow. (Reference your diagram in your answer).</p> <p>Explain the relationship between the structure of the matrix and the Kreb's cycle.</p>
C.3.7 Analyse data relating to respiration.	<p>Calculate how much ATP is made at each stage of aerobic cellular respiration from 1 glucose molecule. List the amount of ATP formed in each stage. Your total should be around 34 ATP.</p> <p>Glycolysis –</p> <p>Link reaction –</p> <p>Kreb's cycle –</p> <p>Oxidative Phosphorylation -</p>

## C4 Photosynthesis

Assessment Statement	Study Information
C.4.1 Draw and label a diagram showing the structure of a chloroplast as seen in electron micrographs.	Draw a diagram of a chloroplast. Be sure to label the outer membrane, thylakoid, thylakoid membrane, inner thylakoid space, grana, and stroma.
C.4.2 State that photosynthesis consists of light-dependent and light-independent reactions.	Summarize the light-dependent reaction and state where it occurs in the chloroplast.

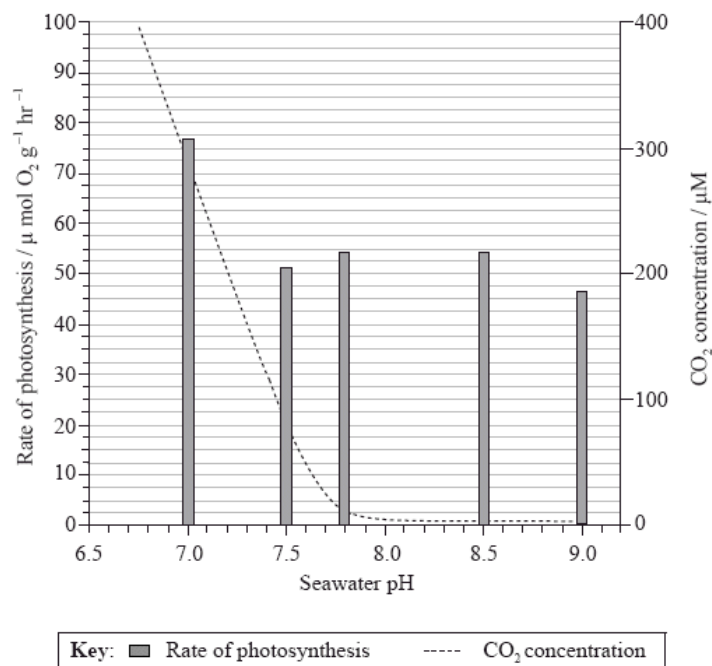


	Summarize the light-independent reaction and state where it occurs in the chloroplast.
C.4.3 Explain the light-dependent reactions.	<p>Draw a diagram of photosystem I and II and their associated electron transport chains.</p> <p>Use the diagram to explain how water is oxidized, ATP is formed, and NADPH is formed.</p>
C.4.4 Explain photophosphorylation in terms of chemiosmosis.	Draw a diagram of ATP synthase. Explain the flow of $H^+$ and the formation of ATP.
C.4.5 Explain the light-independent reactions.	Draw the calvin cycle (light-independent reaction). Label the enzyme Ribulose biphosphate carboxylase (Rubisco).



C.4.9 Analyse data relating to photosynthesis.

The rate of photosynthesis in the marine seagrass, *Zostera marina*, was investigated under a range of pH conditions. After a period of darkness, the plants were illuminated at a constant light intensity at 15°C and the rate of photosynthesis was measured. *Zostera marina* can use both dissolved carbon dioxide (CO<sub>2</sub>) and hydrogen carbonate ions for photosynthesis. The rate of photosynthesis is plotted on the y-axis on the left. In addition, the concentration of carbon dioxide was measured for each pH investigated and is plotted on the y-axis on the right.



State the carbon dioxide concentration at pH 7.2. [1] \_\_\_\_\_

Calculate the percentage decrease in the rate of photosynthesis from pH 7 to pH 7.5. [1]

Outline the relationship between pH and the rate of photosynthesis. [2]